

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D	06 JUL 2005
WIPO	PCT

Applicant's or agent's file reference 11253P-WO	FOR FURTHER ACTION	
	See Form PCT/IPEA/416	
International application No. PCT/EP2004/003804	International filing date (day/month/year) 08.04.2004	Priority date (day/month/year) 09.04.2003
International Patent Classification (IPC) or national classification and IPC H02J3/88, F03D9/00		
Applicant GENERAL ELECTRIC COMPANY et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 9 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
  - (*sent to the applicant and to the International Bureau*) a total of 4 sheets, as follows:
    - sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)), containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
 

<input checked="" type="checkbox"/> Box No. I	Basis of the opinion
<input type="checkbox"/> Box No. II	Priority
<input type="checkbox"/> Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/> Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/> Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/> Box No. VI	Certain documents cited
<input type="checkbox"/> Box No. VII	Certain defects in the international application
<input type="checkbox"/> Box No. VIII	Certain observations on the international application

Date of submission of the demand 29.10.2004	Date of completion of this report 05.07.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Lorenzo Feijoo, S Telephone No. +49 89 2399-7993

## **INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

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### **Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
    - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
      - international search (under Rules 12.3 and 23.1(b))
      - publication of the international application (under Rule 12.4)
      - international preliminary examination (under Rules 55.2 and/or 55.3)
  2. With regard to the **elements\*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

### Description, Pages

1-10 as originally filed

#### **Claims, Numbers**

1-18 received on 15.09.2004 with letter of 15.09.2004

### **Drawings Sheets**

1/6-6/6 as originally filed

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3.  The amendments have resulted in the cancellation of:  
 the description, pages  
 the claims, Nos.  
 the drawings, sheets/figs  
 the sequence listing (*specify*):  
 any table(s) related to sequence listing (*specify*):

4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).  
 the description, pages  
 the claims, Nos.  
 the drawings, sheets/figs  
 the sequence listing (*specify*):  
 any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-18
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-18
Industrial applicability (IA)	Yes:	Claims	1-18
	No:	Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

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**Re Item V.**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

- 1 The following documents are referred to in this communication:
  - D1: Third International Workshop On Transmission Networks For Offshore Wind Farms (04-2002), Wind Farm Control Software Structure
  - D2: KONLOGIANNIS C C ET AL: "An efficient power management and control in wind parks by means of a radio telemetry control system" ELECTROMOTION'01. 4TH INTERNATIONAL SYMPOSIUM ON ADVANCED ELECTROMECHANICAL MOTION SYSTEMS. PROCEEDINGS, PROCEEDINGS OF 4TH INTERNATIONAL SYMPOSIUM ON ADVANCED ELECTROMECHANICAL MOTION SYSTEMS - ELECTROMOTION 2001, BOLOGNA, ITALY, 19-20 JUNE 2001, October 2001 (2001-10), - 20 October 2001 (2001-10-20) pages 461-465 vol.2, XP001154444 2001, Bologna, Italy, Univ. Bologna, Italy ISBN: 88-900615-0-2
  - D3: DE 196 20 906 A (SIEMENS AG) 8 January 1998 (1998-01-08)
  - D4: 7th Ieee International Power Electronics Congress. Technical Proceedings. Ciep 2000 (cat. No.00th8529), Proceedings Of Ciep 2000. 7th Ieee International Power Electronics Congress, Acapulco, Mexico, 15-19 Oct. 2000 (0000), Modeling and dynamic regulation of a wind farm, 293-297
  - D5: WO 03 030329 A (WOBBEN ALOYS) 10 April 2003 (2003-04-10)
  - D6: First/second International Workshop On Transmission Networks For Offshore Wind Farms (03-2001), Grid Connection and Remote Control for the Horns Rev 150MW Offshore Wind Farm in Denmark, 1-11
  - D7: DE 100 22 974 A (WOBBEN ALOYS) 22 November 2001 (2001-11-22)
- 2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **independent claims 1 and 11** does not involve an inventive step in the sense of Article 33(3) PCT.
  - 2.1 The document D1 is regarded as being the closest prior art to the subject-matter of **claim 1**, and discloses (the references in parentheses applying to this document):
  - 2.2 D1 shows a control software structure for wind farms. A supervisory controller (wind farm main controller) acting as interface between the grid operational system and the wind turbine units of the farm is disclosed. The wind farm controller is responsible for the power set point distribution and proper scheduling methods for running the farm and also provides voltage and frequency control capabilities.

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Thus, in respect of **claim 1**, document **D1** discloses (the references in parentheses applying to this document):

- *a wind farm* (page 2, Fig. 1, wind farm unit) *with at least two wind turbines* (Fig. 1, wind turbine units 1, 2... n) *connected to a power grid* (power grid) further *comprising*
  - *a coupling device* (page 2, Fig. 1, substation) *for coupling the wind farm to the power grid* (power grid)
  - *a sensor element* (page 5, Fig. 3 shows data measured and transmitted to the control unit; page 6, paragraph 4, Data section; page 1, last paragraph: monitoring of operational data of the plant) *for sensing a first variable representative of said wind farm*
- wherein
- *said sensor is adapted to transmit said measured first variable to said coupling device* (Fig. 1, page 2; substation and communication line)
  - *a control unit* (Fig. 1, wind farm controller) *connected to said at least two wind turbines*
  - *a sensor unit* (page 5, Fig. 3 shows data measured and transmitted to the control unit; page 6, paragraph 4, Data section) *connected to said power grid and said centralized control unit*
- wherein
- *said sensor unit is adapted to measure the grid frequency of said power grid and to transmit said measured frequency to said control unit* (the measurement of the frequency grid and transmission to the wind farm controller is implicit when the wind farm controller provides primary control, which has a clear technical meaning that the controller alter power delivered by the generators until balance is re-established between power output and consumption, when the frequency exceeds the permissible limits),
  - *wherein said control unit is adapted to control the output of real power of said wind farm according to said measured grid frequency* (section 2 Wind Farms, page 2, after Fig. 1, primary operation mode, in this mode the wind farm must be able to participate in frequency and voltage control for the AC grid).

The subject-matter of claim 1 therefore differs from this known in D1 in that: *said coupling device is adapted to control a second variable of said wind farm according*

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*to said measured first variable.*

The problem to be solved by the present invention may therefore be regarded as regulation and control of the wind farm on the basis of the internal state of the wind farm.

The solution proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

D1 remains silent about the control capabilities of the coupling device. However D1 discloses different operation modes for a wind farm where regulation and control are performed on the basis of the internal state of the wind farm, i.e (page 2):

- balance control mode: **a power reference is set** by the energy management system, the power output from the wind farm (page 8) is measured (first variable), deviation against a set point is calculated and a variable of the wind farm is regulated according to it.

It is not specified in D1 that said control function is realised by the coupling device.

D3 shows a coupling device (Fig. 3, netzseitige Stromrichterstation 46, see also abstract and Fig. 6, col. 7) which controls a first variable of a wind park according to a second variable of the wind park.

Moreover D6 shows in page 10 that the control functions are also realised by the coupling device (transformator station, see page 10, 11, Fig. 18).

D3 provides the solution defined in claim 1 to the problem identified above in the field of wind parks. A combination of the teachings of D1 and D3 would anticipate the subject-matter of claim 1.

Therefore, the subject-matter of claim 1 lacks inventive step (Art. 33(3) PCT).

- 2.3 The subject-matter of **independent claims 11** corresponds in terms of method features to that of claim 1. The objections raised in respect of this latter claim, therefore, apply mutis mutandis, to the subject-matter of independent claims 11 which do thus not meet the requirements of Art. 33 (3) in respect of inventive step.

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- 3 Dependent claims **2-10 and 12-18** do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the EPC with respect inventive step, the reasons being as follows:

**Claim 2** defines that "*the sensor unit is a separate substation or integrated into one of said at least two wind turbines*". This feature is disclosed in D7 (see Fig. 3, paragraph 0017).

**Claims 3 and 14** define that "*the control unit is adapted to shut down individual wind turbines within the wind farm*". This feature is disclosed in D1 (see page 8, section 4 Wind Farm Main Controller, Fig. 5, 6 and Wind Farm Management Block and Unit Scheduler Function, pages 9-10).

**Claim 4** defines that "*a centralized control unit is adapted to gradually reduce the power output of individual wind turbines within the wind farm*", which is disclosed by D1, see pages 8-9, section 4 Wind Farm Controller , 13, Pitch Control Object Block.

**Claim 5** defines that "*the control unit comprises a selection unit for selecting individual wind turbines within the wind farm*". This feature is disclosed in D1 (see page 8, section 4 Wind Farm Main Controller, Fig. 5, 6 and Wind Farm Management Block and Unit Scheduler Function, pages 9-10).

**Claim 6** defines that "*the sensor unit is adapted to transmit said measured grid frequency to said control unit by radio, optical, sound and electrical signal means*". This feature is disclosed in D1, see Fig. 1 and page 2, first paragraph. D6 (page 10-11) and D2 (page 465, column 1) also discloses this feature.

**Claim 7** defines that "*the sensor element is integrated into said coupling device*". This feature is disclosed in D3, Fig. 6, 46, Ud\_i and Id\_i measurements at the terminals 56 and 58.

**Claim 8** defines that the first variable is the actual power output of the wind farm, the total current output of the wind farm or the actual voltage at the point of coupling. This

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is disclosed by **D3**, Fig. 6, col. 7, Leistungs-Istwert  $P_d_i$ .

**Claim 9** defines that the second variable is the total current output. This is disclosed by **D3** Fig. 6, col. 7, Sollwertepaar  $U_o_i$  and  $I_o_i$ .

**Claim 10** defines that "*the coupling device comprises semiconductor switching devices to regulate the power output*". This is disclosed by **D3**, Abstract, Fig. 3, 46 netzseitige Stromrichterstation, 50 Wechselrichter.

**Claim 12** defines that said second variable is the actual voltage at the point of coupling. This is disclosed by **D3**, Fig. 6, col. 7.

**Claim 13** defines "*the criteria for selecting the at least one turbine are life time, maintenance considerations and operating or load conditions of an individual wind turbine*". This feature is disclosed in **D1**, see page 10, Unit Scheduler Function.

**Claim 17** defines operation of the wind fam at maximum total power output while frequency stays within a predetermined range and reduction of the power output when the grid frequency exceeds upper boundary value of said range. This feature is disclosed in **D1**. **D1** shows different operation modes that might be used by the wind farm controller to run the wind farm under different conditions, eg: running the wind farm at maximum power level and switch to primary control in case of overfrequency (see page 2, second paragraph).

In respect of **claim 18**, **D1** shows different operation modes that might be used by the wind farmer controller to run the wind farm under different conditions, eg: running the wind farm in power balance mode, so that set point is received from the EMS and distributed to each single wind turbine by the wind farm main controller, where the set point might be under maximum and switching to primary mode if the frequency exceeds permissible limits (page 2).

**Re Item VI.**

**Certain documents cited**

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Certain published documents

Application No Patent No	Publication date (day/month/year)	Filing date (day/month/year)	Priority date ( <i>valid claim</i> ) (day/month/year)
WO03030329	10/04/2003	21/09/2002	28/09/2001

**Re Item VIII.**

- 1   **Claims 15 and 16** define identical subject-matter. The applicant is requested to remove one of them.
- 2   The present application does not meet the requirements of Art. 6 in respect of **clarity** for the following reasons:
  - **Claims 17 and 18:** the formulation of said claims is not clear, since it is not evident if the claims refer to part of the claims 11-16 or to the claims 11-16 as a whole. The following formulation would seem to overcome the objections of clarity: " a procedure/method according to any of claims 11-16, comprising the steps of:"

**Claims as amended under Art. 19 PCT**

1. A wind farm with at least two wind turbines (1, 2, 3, 4) connected to a power grid, further comprising
  - 5 a coupling device (7) for coupling the wind farm to the power grid,
  - 10 a sensor element (8) for sensing a first variable representative of said wind farm, wherein said sensor element (8) is adapted to transmit said measured first variable to said coupling device (7),
  - 15 a control unit (5) connected to said at least two wind turbines (1, 2, 3, 4), and
  - 20 a sensor unit (6) connected to said power grid and said centralized control unit (5), wherein said sensor unit (6) is adapted to measure the grid frequency of said power grid and to transmit said measured grid frequency to said control unit (5), and
  - 25 wherein said coupling device (7) is adapted to control a second variable of said wind farm according to said measured first variable, and
  - wherein said control unit (5) is adapted to control the output of real power of said wind farm according to said measured grid frequency, and
2. The wind farm according to claim 1, wherein said sensor unit (6) is a separate substation or integrated into one of said at least two wind turbines (1, 2, 3, 4).
3. The wind farm according to claim 1 or 2, wherein said control unit (6) is adapted to shut down individual wind turbines within the wind farm.
- 35 4. The wind farm according to any of the preceding claims, wherein centralized control unit (6) is adapted to gradually and/or continuously reduce the power output of individual wind turbines within the wind farm.

5. The wind farm according to any of the preceding claims, wherein said control unit (6) further comprises a selection unit for selecting individual wind turbines (1, 2, 3, 4) within said wind farm.
- 5 6. The wind farm according to any of the preceding claims, wherein said sensor unit (6) is adapted to transmit said measured grid frequency to said control unit (5) by radio, optical, sound or electrical signal means.
- 10 7. The wind farm according to any of the preceding claims, wherein said sensor element (8) is integrated into said coupling device (7).
- 15 8. The wind farm according to any of the preceding claims, wherein said first variable is the actual power output of the wind farm, the actual output current of the wind farm or the actual voltage at the point of coupling to the power grid.
9. The wind farm according to any of the preceding claims, wherein said second variable is the total current output of the wind farm.
- 20 10. The wind farm according to any of the preceding claims, wherein the coupling device comprises semiconductor switching devices for controlling the power output of said wind farm.
- 25 11. A method for operating a wind farm according to any of claims 1 to 10, said method comprising the steps of:
  - measuring a first variable representative of said wind farm by said sensor element,
  - 30 measuring the grid frequency with a sensor unit,
  - transmitting said measured first variable to a coupling device,
  - 35 transmitting said measured grid frequency to a control unit,
  - determining whether the measured first variable lies outside a predetermined range, and, if the measured first variable lies outside the predetermined range, selecting at least one out of the at least two wind turbines comprised in said wind farm by said coupling device and

regulating the power output of said selected at least one wind turbine by controlling a second variable of said wind farm, and

5 determining whether the measured grid frequency lies outside a predetermined range, and, if the measured grid frequency lies outside said predetermined range, selecting at least one out of the at least two wind turbines comprised in said wind farm by said control unit and regulating the power output of said selected at least one wind turbine.

10 12. The method according to claim 11, wherein said second variable is the current output of said selected at least one wind turbine or the actual voltage at the point of coupling to the grid.

15 13. The method according of claim 11 or 12, wherein the criteria for selecting the at least one wind turbine are life time and/or maintenance considerations and/or operating or load conditions of an individual wind turbine.

20 14. The method according to any of claims 11 to 13, wherein the selected at least one wind turbine is shut down or started.

25 15. The method according to any of claims 11 to 13, wherein the controlled variable, especially power output, current output or voltage at the point of coupling to the grid, of said selected at least one wind turbine is reduced or increased gradually.

30 16. The method according to any of claims 11 to 13, wherein the controlled variable, especially power output, current output or voltage at the point of coupling to the grid, of said selected at least one wind turbine is reduced or increased continuously.

17. A procedure for operating a wind farm, comprising the steps of:

35 operating the wind farm at its maximum total power output while the grid frequency stays within a predetermined range, and

reducing the power output according to a method of any of claims 11 to 16 when the grid frequency exceeds the upper boundary value of said range.

18. A procedure for operating a wind farm, comprising the steps of:

5        operating the wind farm at a predetermined power output below the maximum power output of said wind farm while the grid frequency remains within a predetermined range,

10      reducing the power output according to a method of any of claims 11 to 16 when the grid frequency exceeds the upper boundary value of said range, and

15      increasing the power output according to a method of any of claims 11 to 16 when the grid frequency undershoots the lower boundary value of said range.

15